High-Resolution Measurements of Atmospheric CO_2 from the DC-8 during Operation ICE Bridge

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The **AVOCET** instrument will provide in-situ measurements of atmospheric carbon dioxide (CO_2) aboard the NASA DC-8 during Operation ICE Bridge. Recently flown during the International Polar Year Mission ARCTAS (2008), this instrument offers many high performance capabilities including high accuracy and precision; fast-response; continuous; and real-time measurements.

Carbon dioxide measurements are made with a modified LI-COR model 6252 differential, non-dispersive infrared (NDIR) gas analyzer. This dual-celled instrument is composed of a feedback stabilized infrared source, a thermoelectrically cooled solid state PbSe detector, and a narrowband (150 nm) interference filter for selectively passing radiation from the CO_2 4.26 micron absorption band. It achieves high precision by sensing the difference in light absorption between the sample and a reference gas of nearly the same CO_2 concentration, both flowing continuously through identical optical absorption cells. The CO_2 instrument is operated at constant mass flow (1000 cm^3 min^{-1}), pressure (250 torr), and temperature (35˚C). Ambient air samples are acquired via a window-mounted Rosemount inlet, then flow through a permeable membrane dryer to remove $H_2O_{(v)}$ prior to reaching the LI-COR. Frequent but short calibrations are accomplished by periodically flowing reference gas through the instrument's sample cell. By interpolating between these calibrations, slow drifts in instrument response are effectively suppressed, yielding high precision values. Reference gas CO_2 concentrations are established relative to the WMO primary calibration standards maintained at the NOAA GMD laboratory in Boulder, CO.

Table 1. Instrument performance characteristics

Dynamic Range	0 to 3000 ppm
Accuracy	± 0.25 ppm
Precision	≤ 0.1 ppm (1σ)
Data reporting interval	1 second

The high-resolution measurements that we offer will be quite useful for examining the large-scale distribution of CO_2 within the heavily under-sampled southern hemisphere during austral spring. Acquired data will be invaluable for the validation of CO_2 retrievals from the AIRS instrument on Aqua, a satellite comprising part of NASA's A-train constellation. These observations will also have intrinsic merit for carbon cycle studies as there are few if any high-resolution airborne observations of atmospheric CO_2 over the region of Antarctica to be explored during Operation ICE Bridge.

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